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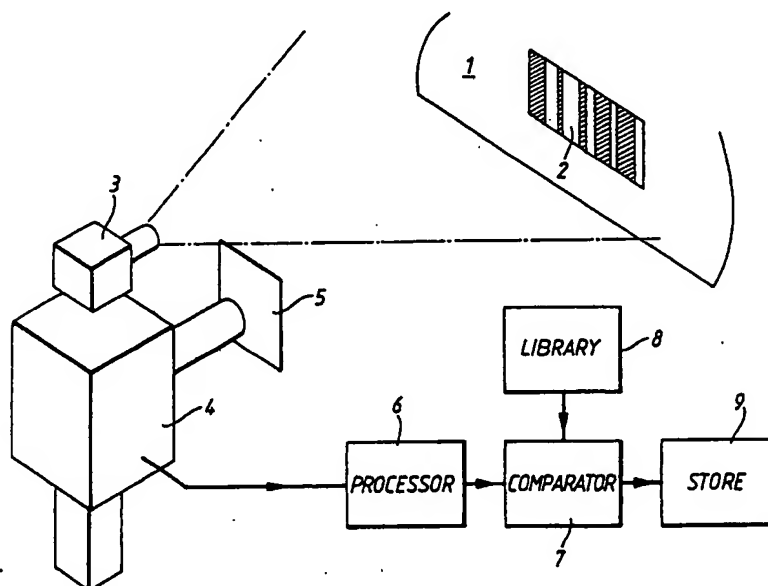
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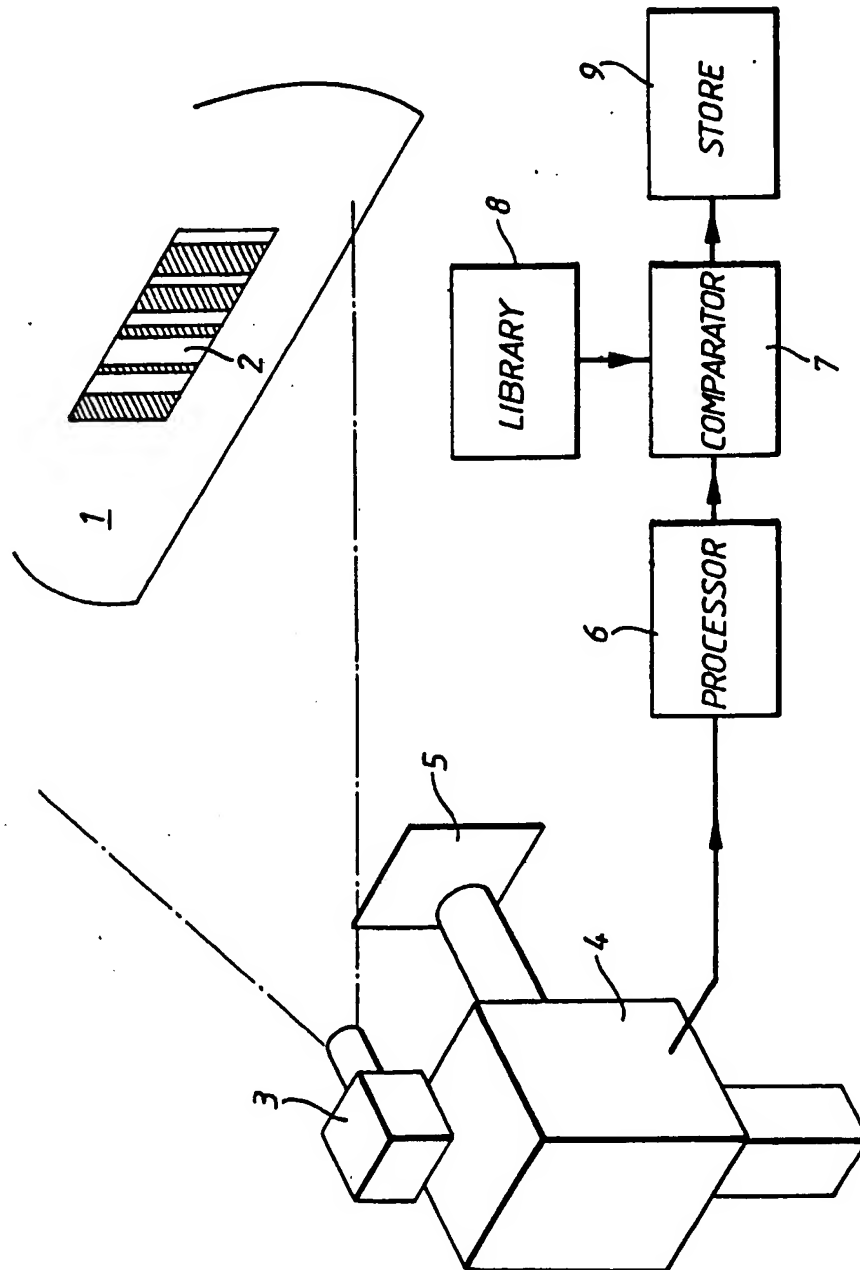
(54) **Apparatus for monitoring the presence or movement of an object**

(57) Apparatus for monitoring the movement of an object includes a bar code 2 having retro-reflective parts which are fixed to the object to be monitored, such as for example, a vehicle 1. The bar code 2 is arranged to be illuminated by a source of infra-red radiation 3 which is carried by the housing of a CCD camera 4. Infra-red radiation reflected from the bar code 2 is incident on the detector array of the camera 4 via an infra-red pass filter 5. Such an arrangement enables the bar code 2 to be easily detected by the CCD camera 4 even in high ambient lighting conditions.



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Apparatus for Monitoring the Presence  
or Movement of an Object

This invention relates to apparatus for monitoring the presence or movement of an object.

5        In a known arrangement for detecting the presence of an object and monitoring its movement, a bar code is arranged to move with the object and typically comprises alternate strips of non-reflective and retro-reflective material. The bar code is read by directing a laser beam  
10        onto it via scanning optics, such as a rotating member having a reflective face or faces. The beam is reflected from the retro-reflective material and directed onto a detector via the rotating member. Since the detector is arranged in a line of sight with the laser beam source,  
15        via the reflective member, large ambient lighting levels may be tolerated without significant degradation in performance. However, the member may be required to rotate at speeds of several thousand revolutions per minute, and in such applications problems exist in  
20        maintaining accurate alignment of the arrangement and providing a robust device.

      In an alternative arrangement, the use of a charge coupled device (CCD) camera has been proposed for reading bar codes. However, this has not proved satisfactory  
25        because typical ambient lighting conditions result in detection of the bar code being extremely difficult or even impossible. The output of the CCD camera must

undergo extensive computer processing, which is therefore expensive, to enable useful information to be extracted.

The present invention seeks to provide improved apparatus for monitoring the position or movement of an object in which the above problems are reduced or  
5 eliminated.

According to the present invention there is provided apparatus for monitoring the presence or movement of an object comprising a reflective portion arranged to move  
10 with the object, a source of electromagnetic radiation arranged to illuminate the reflective portion, detector means, and filter means being preferentially transmissive to electromagnetic radiation falling within a particular wavelength distribution which includes radiation reflected  
15 by the portion and arranged such that transmitted radiation is incident on the detector means. The filter means may be suitably chosen to enable ambient illumination to be substantially excluded from the detector means whilst permitting light received from the  
20 portion to be transmitted. Apparatus in accordance with the invention is thus particularly suitable for use with detector means comprising a high update rate camera such as a CCD or vidicon. Thus, apparatus in accordance with the invention enables mechanical robustness to be achieved  
25 whilst reducing the need for expensive computer processing of an output signal from the detector means. The considerable merits of a CCD camera, for example, may

therefore be more fully taken advantage of than has previously been the case.

Preferably, the portion comprises a retro-reflective material and advantageously, where the portion comprises retro-reflective material, the source is arranged such that its output is in substantially the same direction as the direction of view of the detector means. This may conveniently be accomplished by arranging that the source is arranged to move with the detector means. Such an arrangement permits the reflective portion to be illuminated with a large amount of electromagnetic radiation falling within the said wavelength distribution, compared to the ambient radiation, thus ensuring that the portion stands out when compared with its background.

It is preferred that the electromagnetic radiation preferentially transmitted by the filter means is in the infra-red part of the spectrum.

Advantageously, the portion is a bar code which may be arranged to identify a particular object. Where the portion is a bar code, advantageously the detector means includes a linear array of detector elements orientated substantially parallel to the direction in which the bar code is extensive.

One way in which the invention may be performed is now described by way of example, with reference to the accompanying drawing in which the sole figure schematically illustrates apparatus in accordance with the

invention.

With reference to the figure, apparatus in accordance with the invention is used to identify vehicles passing a particular position. Each vehicle 1 bears a bar code portion 2 which has alternate non-reflective and retro-reflective strips along its length. The bar code 2 is fixed to the side of the vehicle 1 and represents a code which is uniquely associated with that vehicle.

As the vehicle passes the location where the apparatus is installed, the bar code 2 is illuminated with a wide beam of infra-red electromagnetic radiation from a source 3 which is attached to the housing of a CCD camera 4. Radiation is reflected from the retro-reflective parts of the bar code 2 to the camera 4 via a filter 5, which is such that it passes infra-red radiation and is opaque to radiation in other parts of the spectrum. Thus, even in conditions of high intensity ambient radiation, the bar code 2 is clearly detectable against the background.

In this embodiment, the array of detector elements of the CCD camera 4 is linearly arranged in a substantially parallel orientation to the direction in which the bar code 2 is extensive. The detector array is electronically addressed to read-out the stored information and the output signal applied to processing circuitry 6. The output signal of the processing circuitry 6 is representative of the bar code 2 and is compared at 7 with data from a library 8 of data representing bar codes to

identify the particular bar code, and hence vehicle, which has been monitored. This information is then transmitted to a store 9 for later evaluation or for comparison with information received from other similar installations located at different positions for monitoring the movements of vehicles in a fleet.

CLAIMS

1. Apparatus for monitoring the presence or movement of an object, comprising: a reflective portion arranged to move with the object, a source of electromagnetic  
5 radiation arranged to illuminate the reflective portion, detector means, and filter means being preferentially transmissive to electromagnetic radiation falling within a particular wavelength distribution which includes radiation reflected by the portion and arranged such that  
10 transmitted radiation is incident on the detector means.
2. Apparatus as claimed in claim 1 wherein the detector means comprises a high update rate camera.
3. Apparatus as claimed in claim 2 wherein the detector means includes an array of detector elements which is  
15 electronically addressed to provide an output signal.
4. Apparatus as claimed in claim 3 wherein the detector means comprises a CCD camera.
5. Apparatus as claimed in any preceding claim wherein the portion comprises retro-reflective material.
- 20 6. Apparatus as claimed in claim 5 wherein the source is arranged such that its output is in substantially the same direction as the direction of view of the detector means.
7. Apparatus as claimed in claim 6 wherein the source is fixed to move with the detector means.
- 25 8. Apparatus as claimed in any preceding claim and wherein the electromagnetic radiation which is arranged to be preferentially transmitted by the filter means is in



the infra-red part of the spectrum.

9. Apparatus as claimed in any preceding claim and wherein the portion bears a code which is imposed on the reflected electromagnetic radiation.

5 10. Apparatus as claimed in claim 9 wherein the portion is encoded with a bar code.

11. Apparatus as claimed in claim 10 and wherein detector means includes a linear array of detector elements arranged to be orientated substantially parallel to the  
10 direction in which the bar code is extensive.

12. Apparatus as claimed in claim 9, 10 or 11 and including comparison means arranged to compare the code imposed on the electromagnetic radiation with a library of codes whereby the imposed code is identified.

15 13. An arrangement including apparatus as claimed in any preceding claim and a plurality of detector means arranged at respective different locations whereby movement of the object from one location to another is monitored.

14. Apparatus for monitoring the position or movement of  
20 an object substantially as illustrated in and described with reference to the accompanying drawing.